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Early Stage Value Co-Creation Network – Business Relationships Connecting High-Tech B2B Actors and Resources: Taiwan Semiconductor Business Network Case

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ABSTRACT

Purpose:

The purpose of this study is to identify types and features of business relationship when the value co-creation phenomenon is extended to an early stage of the value chain, in which technological innovation is essential, in a high-tech business-to-business (B2B) market.

Methodology/Approach:

The methodology of building a theory from a case study is adopted in this study to propose an early stage value co-creation network. Qualitative data was coded based on grounded theory coding after collecting triangulation data from multiple sources.

Findings:

In a high-tech B2B market, three types of business relationships (supplier-customer mutual, supplier-centric, and network-based business relationship) co-create values at an early stage of the value chain. Intellectual resource, efficiency resource, and supplier-centric business relationships are uniquely found in this stage.

Research Implications:

Our study provides new insight suggesting that the notion of value co-creation can be extended to early stages of the value chain in a high-tech B2B market. Additionally, our research identifies vital business relationships and how these relationships develop successfully at an early stage value co-creation network in a high-tech B2B market.

Managerial Implications:

Technology development managers at an early stage of the value chain can co-create relationship benefits by building proposed business relationships integrating resources in a

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high-tech B2B market. Additionally, marketing managers should consider the early stage as another source of value co-creation.

Originality/Value/Contribution of the Paper:

The notion of value co-creation is extended from the later stage to an early stage of the value chain in a high-tech B2B market. Consolidated framework of a value co-creation network integrating actors, resources, and relationships, suggested in this study, will be valuable for further theoretical research and business application.

Keywords: value co-creation, early stage, business relationship, actor, resource, high-tech B2B

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1. Introduction

Value creation can be regarded as "the raison d'être" of collaborative customer-supplier relationships in the business-to-business (B2B) market because the essential purpose of customers and suppliers engaging in a collaborative relationship is to work together to add value (Anderson, 1995). The business relationship is defined as an intercompany interaction, with traits of mutual orientation and commitment over time, and actors involved are interdependent in developing a collaborative business relationship (Håkansson and Snehota, 1995; Håkansson, 1982). Business relationships that constitute a B2B market may be differentiated from the business-to-consumer (B2C) market in terms of market structure, customers' demands, and the decision process (Armstrong and Kotler, 2011) since the supply chain of a B2B market consists of complex business relationships.

In the general B2B market, the value co-creation phenomenon has focused on a later stage of the value chain, in which marketing capability is essential, (Guenzi and Troilo, 2006; Golfetto and Gibbert 2006) as presented in Figure 1a, because suppliers can develop a direct relationship and collaborate with customers using marketing capability. Development of marketing capabilities (market-based organizational learning, market sensing, and customer linking) better meets customers' expectations (Guenzi and Troilo, 2006) and marketing competencies, such as customer relationship management and channel design, lead to superior financial returns as a source for customer value (Golfetto and Gibbert 2006). When the value co-creation phenomenon is observed at a later stage of the value chain, momentum

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of value co-creation shifts towards customers (Grönroos, 1997; Prahalad and Ramaswamy, 2000; Vargo and Lusch, 2008; Payne, et al., 2008). Thus, a business relationship with customers is critical for value co-creation at the later stage of the value chain in the B2B market.

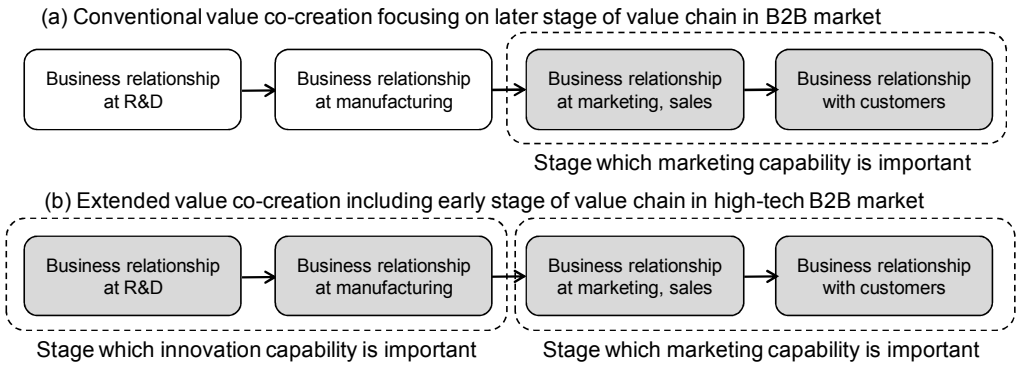
(a) Conventional value co-creation focusing on later stage of value chain in B2B market
Business relationship at R&D
Business relationship at manufacturing
Business relationship at marketing, sales
Business relationship with customers
Stage which marketing capability is important
(b) Extended value co-creation including early stage of value chain in high-tech B2B market
Business relationship at R&D
Business relationship at manufacturing
Business relationship at marketing, sales
Business relationship with customers
Stage which innovation capability is important
Stage which marketing capability is important

Figure 1. Conventional and extended value co-creation in value chain of B2B and high-tech B2B market.

However, high-tech B2B markets, such as biotechnology, aircraft, communication equipment, medical instruments, and semiconductor industries, require more technological innovation than the general B2B market since technology development in these areas is highly sophisticated, accommodating complex customer requirements, and considerable resources and time are required during technology development. Additionally, many actors including suppliers, partners, or customers of subcomponents or components are involved in the supply chain to develop sophisticated technology, and complex business relationships will develop among actors in a high-tech B2B market, presented in Figure 2. In this study, the supply chain network consisting of suppliers, partners, and customers is focused to explore value co-creation phenomenon at an early stage in a high-tech B2B market.

The value co-creation can be viewed with a particular form of open innovation due to customers' involvement in new products or services (Frow, et al., 2015; Barczak, 2012). Because value co-creation offers significant opportunities for innovation (Frow, et al., 2015) and technological innovation is critical at an early stage, we raised questions if value co-creation can be extended to an early stage of the value chain, such as research and development (R&D), in a high-tech B2B market, presented in Figure 1b. Possibility of an early stage value co-creation phenomenon has been discussed by researchers. O'Cass and Ngo (2012) addressed supplier's innovation capability for technology development as a source of value co-creation, and Park and Lee (2015) argued that early stage value co-

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creation process is observed at dyadic supplier-customer business relationship. Despite significance of the early stage of the value chain for technological innovation in a high-tech B2B market, the value co-creation phenomenon at an early stage has not been extensively studied. Moreover, the business relationship network including multiple actors for early stage value co-creation in a high-tech B2B market has not been discussed.

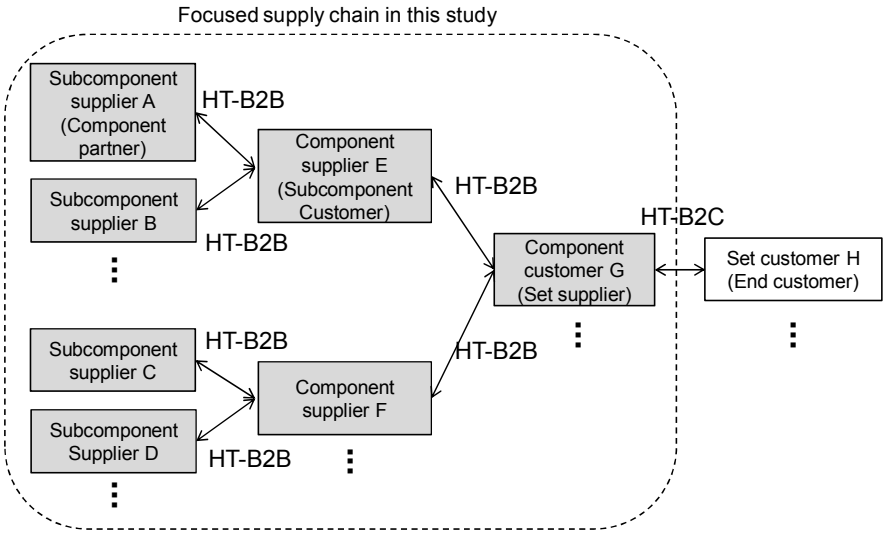

Figure 2. Comparison of high-tech B2B and B2C transactions in the supply chain.

When the value co-creation phenomenon is considered in the early stage in a high-tech B2B market, theoretically interesting questions are raised as to if business relationships can be developed to co-create values among participating actors at the early stage of the value chain, considering characteristics of the high-tech B2B market. Additionally, we raised an associated question as to which business relationship composed of early stage value co-creators will be vital in co-creating of values, contributing to technological innovation in a high-tech B2B market.

Thus, research questions for this study are summarized as follows.

Research Question 1: *Can business relationships be developed to co-create values at an early stage of the value chain, in which technological innovation is essential, in a high-tech B2B market?*

Research Question 2: *What is the most vital business relationship developed by value co-creators to build an early stage value co-creation network in a high-tech B2B market?*

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This paper is structured as follows. First, extant research is reviewed to understand concepts of value co-creation in a B2B market and to construct a prior research framework associated with research questions. Second, case study research based on qualitative data analysis is explained with data collection and analysis methods. Research findings are then described, whereby an early stage value co-creation network including value co-creators and their relationships is proposed as a final construct. Finally, theoretical contributions and managerial implications are discussed, along with future research plans.

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2. Literature Review

2.1. Constitution of value co-creation network in B2B market

2.1.1. Actors

Actors play critical roles in co-creating values in a B2B market, and can be defined as individuals or groups, such as organizations. Customers are addressed as critical value co-creators (Grönroos, 1997; Prahalad and Ramaswamy, 2000; Vargo and Lusch, 2008; Payne, et al., 2008) and value is also created for suppliers although there is strong focus on value for customers (Walter, et al., 2001; Ulaga and Eggert, 2006) in a B2B market. In addition to suppliers and customers, other key network actors are referred to as partners, alliances, and industry sponsors in developing collaborative relationships (Daniel, et al., 2002) or other actors within network systems (Ballantyne, et al., 2011; Frow and Payne, 2011; Möller and Törrönen, 2003). Vargo and Lusch (2008, 2011) suggest that all network actors are critical actors, stating that all social and economic actors (customers, firms, etc.) are service providing and value creating enterprises.

2.1.2. Actor's resources

Actor's resources are suggested as core elements, supporting the value co-creation process. Monetary or human resources are frequently suggested by researchers (Daniel, 2002; Corsaro, et al., 2012). Additionally, integration and absorption of knowledge resource within a supply network through value creation has been highlighted by many researchers (Jaakkola and Hakanen, 2013; Hakanen, 2014; Lacoste, 2016; Eslami and Lakemond, 2016). Associated with knowledge resource, Vargo and Lusch (2008, 2011) defined operant resources (knowledge and skills) more specifically and Jaakkola and Hakanen (2013) argued that experiences, skills, organizational relationships, and operand are identified as required

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resources. Technology is also discussed as a resource since technology is a critical resource that can create values (Vargo, et al., 2015; Akaka and Vargo, 2014) and firms seek resources such as information, knowledge, and technology for service innovation through network relationships (Rusanen, et al., 2014).

2.1.3 Relationships among actors

The significance of business relationships and methods to improve them in the B2B market have been addressed by many researchers. When suppliers develop relationships with customers, demonstrating trustworthiness and commitment to customers is critical to building a successful business relationship (Anderson and Narus, 1998; Mohr and Spekman, 1994; Morgan and Hunt, 1994) and firms should initiate efforts to build good relationships with customers, rather than focus only on the product (Grönroos, 2000; Ravald and Grönroos, 1996). Relationship benefits are found as outcomes of successful business relationships. Relationship benefits, such as service support, personal interaction, supplier's know-how, and customer's time to market, can display a stronger potential for differentiation in key supplier relationships (Ulaga and Eggert, 2006) and relationship benefits may be increased from quality of customer ties (trust, commitment, norms) as well as from the number and decision-making capability of interfirm contacts and interaction among relational drivers (Palmatier, 2008).

Types of business networks are classified as single, dyad or network depending on value recipients (Corsaro, et al., 2012; Jaakkola and Hakanen, 2013), and many-to-many relationships as a strategy to broaden relational approaches have been discussed as part of the network theory (Gummesson and Polese, 2009). The manner in which connectedness of relationships results in varying value potentials of triads among the supplier, customer, and merchant has been explained (Vedel, 2016). Kowalkowski et al. (2016) analyzed the dynamics of triadic value proposition connecting service systems beyond the dyadic relationship between suppliers and customers.

Recent research demonstrates that actors' perception impact development of business relationships (Corsaro and Snehota, 2010; Fiol, et al., 2011; Oinonen and Jalkala, 2015). Perception of actors in a business relationship impact other actors' behavior and development of business relationships, and perceptions are actor specific, largely incomplete, and changing (Corsaro and Snehota, 2010). A perceived value is revealed as a complex and multidimensional construct, comprising elements of a functional, emotional, and social character (Fiol, et al., 2011). Oinonen and Jalkala (2015) argued that each actor's goal must

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be reflected in their perception of co-development, since a supplier has wider ranging perception than a customer or partner.

2.1.4. Summary of literature review on value co-creation network

Extant research indicates the value co-creation phenomenon can be analyzed from the perspective of actors, actors' resources, and relationships among actors in the B2B market, as summarized in Table 1. However, the value co-creation phenomenon has only focused on the later stage in the B2B market, such as marketing or sales, and early stage, such as R&D, in a high-tech B2B market has not been as extensively studied for value co-creation. Moreover, a business relationship network including multiple actors for early stage value co-creation has not been studied in a high-tech B2B market, implying that an iterative approach between theory and data is required to investigate the new field of an early stage value co-creation.

Table 1. Literature review from the perspective of actors, actors' resources, and relationships among actors for value co-creation.

Perspective	Category	References
Actors	Customers	Grönroos (1997), Prahalad and Ramaswamy (2000), Vargo and Lusch (2008), Payne et al. (2008)
	Suppliers	Walter et al. (2001), Ulaga and Eggert (2006)
	Other actors (partners, alliances, industry sponsors, stakeholders etc.)	Daniel et al. (2002), Möller and Törrönen (2003), Ballantyne (2011), Frow and Payne (2011)
	all social and economic actors (customers, firms, etc.)	Vargo and Lusch (2008, 2011)
Actor's resources	Monetary or human resources	Daniel et al. (2002), Corsaro et al. (2012)
	Knowledge resource	Jaakkola and Hakanen (2013), Hakanen (2014), Lacoste (2016), Eslami and Lakemond (2016)
	Operant resources (knowledge and skills)	Vargo and Lusch (2008, 2011), Jaakkola and Hakanen (2013)
	Technology resource	Vargo (2015), Akaka and Vargo (2014)
	Resource access strategies	Rusanen et al. (2014)
Relationships among actors	Customer and supplier business relationship	Anderson and Narus (1998), Mohr and Spekman (1994), Morgan and Hunt (1994), Grönroos (2000), Ravald and Grönroos (1996)
	Relationship benefits as outcomes of successful relationship	Ulaga and Eggert (2006), Palmatier (2008)
	Types of business network (single, dyad or network)	Corsaro et al. (2012), Jaakkola and Hakanen (2013)
	Connectedness of relationships	Vedel (2016)
	Dynamics of triadic relationships	Kowalkowski et al. (2016)
	Many-to-many relationship	Gummesson and Polese (2009)
	Actors' perception on the development of business relationships	Corsaro and Snehota (2010), Fiol et al. (2011), Oinonen and Jalkala (2015)

2.2. A priori construct

Based on literature review, an a priori research framework is constructed to accommodate key components for value co-creation in a high-tech B2B market, including actors, actors' resources, and relationships among actors. Because actors play critical roles in contributing to value co-creation, actors are incorporated as the first key component constituting a value co-

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creation network. Recent research suggests resource integration of actors is critical behavior of actors in co-creating values. Thus, resources connected to actors are also considered as the main component of a prior research framework. Hence, actors will develop a business relationship with other actors to co-create relationship values within a relationship network. Six relationship value benefits (product quality, delivery performance, service support, personal interaction, supplier's know-how, and time to market) (Ulaga and Eggert, 2006) are usefully adopted in our research to examine types of relationship values co-created in a high-tech B2B market. When one of the six relationship value benefits was generated, the event was considered as a value co-creation event. Thus, our research framework is proposed, as shown in Figure 3, to investigate how actors develop business relationships with other actors by integrating resources at an early stage in a high-tech B2B market. This framework can be seen as an a priori construct to understand the grounding of our research construct, that will be refined and expanded in Section 4.3 based on our case study.

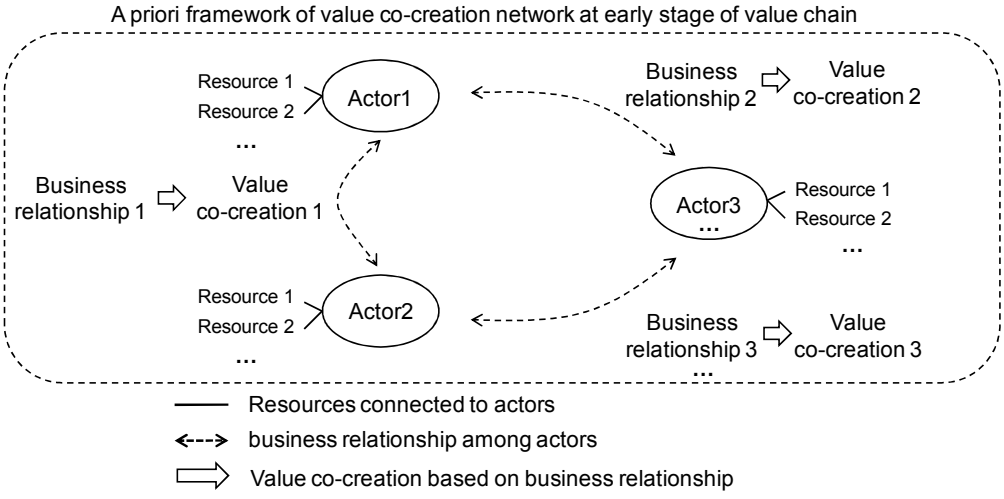

Figure 3. Initial research framework of early stage value co-creation network in terms of actor, resource, and business relationship.

3. Methodology and Data Analysis

3.1. Research methodology

Research methodology adopted in this study was based on case study research (Yin, 2009) and building a theory from a case study (Eisenhardt, 1989). The case study research is selected because it is particularly useful for building theory (Eisenhardt, 1989; Dyer and

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Wilkins, 1991) as well as a deep understanding of actors, their interaction, and behavior in the B2B market (Woodside and Wilson, 2003). We conducted research using seven steps, presented in Figure 4, to build a theory on early stage value co-creation from the case study. In Step 1, initial research questions were defined and a priori construct was built for research, conducted in Sections 1 and 2, respectively. A Taiwan semiconductor business network was selected as a useful case in Step 2. We collected qualitative data from multiple sources (field notes from direct observation, interview data, and secondary data) and multiple investigators analyzed data from a within-case analysis in Steps 3 and 4. Qualitative data analysis was conducted using grounded theory coding (open, axial, and selective coding). We collected further data and overlapped existing analysis through Steps 3A and 4A to reach theoretical saturation in Step 5. Established theory on early stage value co-creation was compared with conflicting or similar research in Step 6. The final theory and construct were built in Step 7.

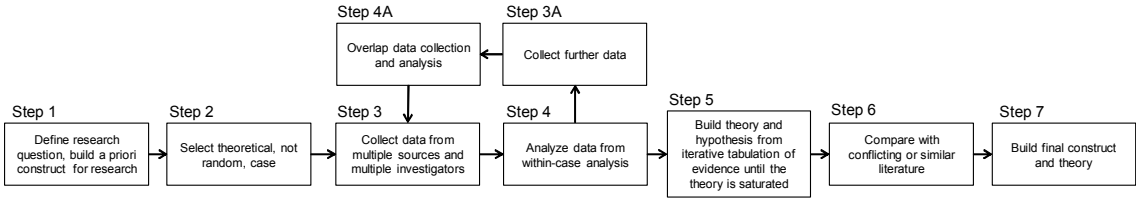
Step 4A
Overlap data collection and analysis
Step 3A
Collect further data
Step 1
Define research question, build a priori construct for research
Step 2
Select theoretical, not random, case
Step 3
Collect data from multiple sources and multiple investigators
Step 4
Analyze data from within-case analysis
Step 5
Build theory and hypothesis from iterative tabulation of evidence until the theory is saturated
Step 6
Compare with conflicting or similar literature
Step 7
Build final construct and theory

Figure 4. Process of building a theory from a case study.

3.2. Case selection

In Step 2, during the research process shown in Figure 4, we selected our case that focused on efforts that were theoretically useful (Glaser and Strauss, 1967). To understand the early stage value co-creation network, we raised the question as to if business relationships can be developed to co-create values at the early stages of the value chain. High-tech B2B markets are appropriate to explore the early stage value co-creation phenomenon since the early stage in the high-tech B2B markets is critical for technological innovation and many actors including suppliers, customers, and partners are involved.

The semiconductor foundry business model[1] was chosen as a theoretically useful case in this study because it has characteristics of a typical high-tech B2B market. This model is closely associated with our research questions since diverse business relationships are built

[1] A foundry business is a business model in which the semiconductor fabrication plant operation is separated from the integrated circuit design operation. Typical foundry players in the semiconductor industry include Taiwan Semiconductor Manufacturing Company Limited(TSMC), United Microelectronics Corporation(UMC), Global Foundries, Samsung Electronics, etc.

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during technology development. In the typical foundry business model, Fabless[2] customers design chips, foundry suppliers are responsible for technology development as well as manufacturing, and foundry partners[3] support chip design & manufacturing, assembly, testing, and shipping. The value co-creation process within the business network is vital for succeeding in the high-tech market because each actor is responsible for their role in the supply chain, and can no longer be considered as having independent functions. In particular, Taiwan's foundry business network is a theoretically useful case because it successfully led the global foundry market as the first mover based on strong business relationships within the business network, co-creating values with each other. Taiwan's foundry business network offers good motivation for research questions and has inspired new ideas as a useful case.

3.3. Data collection and analysis

In Step 3, during the research process shown in Figure 4, we collected multiple data using triangulation, as suggested by Yin (2009) and Woodside and Wilson (2003). Triangulation includes direct observation of research, asking case participants for explanation and interpretation of operational data, and analyses of written documents (Woodside and Wilson, 2003). The first set of triangulation data was collected from direct observation by observing actors, resources, and relationships at an early stage within environments of Taiwan's foundry business network case. Direct observation was summarized by one of the researchers, using field notes over a sufficient period (2013-2015). The second set of triangulation data was collected by undertaking an unstructured interview with 10 case participants, with working experience within Taiwan's business network, for one month in July 2014. The unstructured interview lasted one hour per participant, in which participants were asked to provide explanations and interpretations of building relationships for value co-creation. Secondary data of analyst reports from securities companies (2013-2015), news articles from trade newsletters (EEtimes and Digitimes[4], 2013-2015), websites, and annual reports of

[2] Fabless is the business model for the designing and sales of semiconductor chips while the fabrication of the devices is outsources to a specialized manufacturer called a semiconductor foundry. Typical Fabless players in the semiconductor industry include Qualcomm, nVidia, Broadcom, AMD, MediaTek, Marvell, etc.

[3] Typical design partners in the semiconductor industry include Synopsys, Cadence, ARM, etc. Typical manufacturing partners in the semiconductor industry include ASML, AMAT, TEL, etc. Typical assembly and testing partners in the semiconductor industry include Amkor, SPIL, Statschippac, etc.

[4] Electronic Engineering Times(EE Times) is an online electronics industry magazine offering news, columns, and feature articles for semiconductor manufacturing, communications, electronic design automation, electronic engineering, technology, and products. EE Times employs a total of 30 editors, with a readership of 141,100. DigiTimes is a daily newspaper for semiconductor, electronics, computer, and communications industries in Taiwan and the Greater China

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related companies were collected as the third set of triangulations, to strengthen grounding of the theory (Yin, 2009; Eisenhardt, 1989). Exploratory research was conducted to extract meaningful data that highly relevant to the research topics. Forty-one sets of field notes, 7 interview results, one analyst report, 10 news articles, and 20 documents from web sites as well as annual reports were selected. Data sources with a description of extracted events are provided in Appendix A.

In Step 4, as presented in Figure 4, collected data was coded based on grounded theory coding, as suggested by Strauss and Corbin (1998), because the grounded theory is useful to explore the new field of early stage value co-creation by using an iterative approach and analyze data consisting of direct observation, unstructured interview or case studies (Wagner, et al., 2010). Drawing on their grounded theory approach, Strauss and Corbin (1998) distinguished between three types of coding practice: open coding, axial coding, and selective coding. Main concepts of findings were induced from collected data, as explained in Figure 5, corresponding to the process of open coding. Coding and data analysis were conducted by combining manual analysis with a Computer-Assisted Qualitative Data Analysis Software (CAQDAS),[5] to have ownership of the analysis. An example of data coding using CAQDAS to extract concepts is provided in Appendix B-1. Concepts were then categorized from a lower level to a higher level of abstraction, as explained in Figure 5, that is a process of axial coding. Categories were named at a higher level, consolidating meaning of concepts. An example of data coding using CAQDAS to categorize concepts is provided in Appendix B-1.

Coded data were displayed according to qualitative data analysis methodology by describing events and counting events (Miles and Huberman, 1994). Central features of grounded theory are that it is concerned with development of theory out of data and has an iterative or abductive approach (Bryman and Bell, 2007; Reichertz, 2007). If new data collected related to our research questions or if a new line of thinking emerged during research in Steps 3A and 4A shown in Figure 4, data collection was altered to better ground the theory of an early stage value co-creation network and to provide new theoretical insight, as suggested by Eisenhardt (1989). Our research team held regular meetings every month (total of 35 meetings) to discuss findings and progress. As explained in Figure 5, the theory was

region, and includes over 1,300 member companies.

[5] Computer Assisted Qualitative Data Analysis Software (CAQDAS) offers tools that assist with qualitative research such as transcription analysis, coding and text interpretation, recursive abstraction, content analysis, discourse analysis, grounded theory methodology, etc. Typical CAQDAS software includes ATLAS.ti, MAXQDA, NVivo, QDA Miner, WeftQDA, etc.

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developed by systematically relating core categories to other categories, or core theories to other theories, according to the procedure of selective coding. An example of data coding using CAQDAS to build theories is provided in Appendix B-2.

Research reliability was improved by using two investigators to analyze results and by conducting regular meetings to discuss data results. Internal validity was verified from multiple data sources using triangulation (e.g. field notes from direct observation, interview data, and secondary data), while generalization of the theory in terms of external validity improved by addressing theoretical implications compared with extant literature. When theoretical saturation was reached for this case, additional data collection based on grounded theory coding ceased.

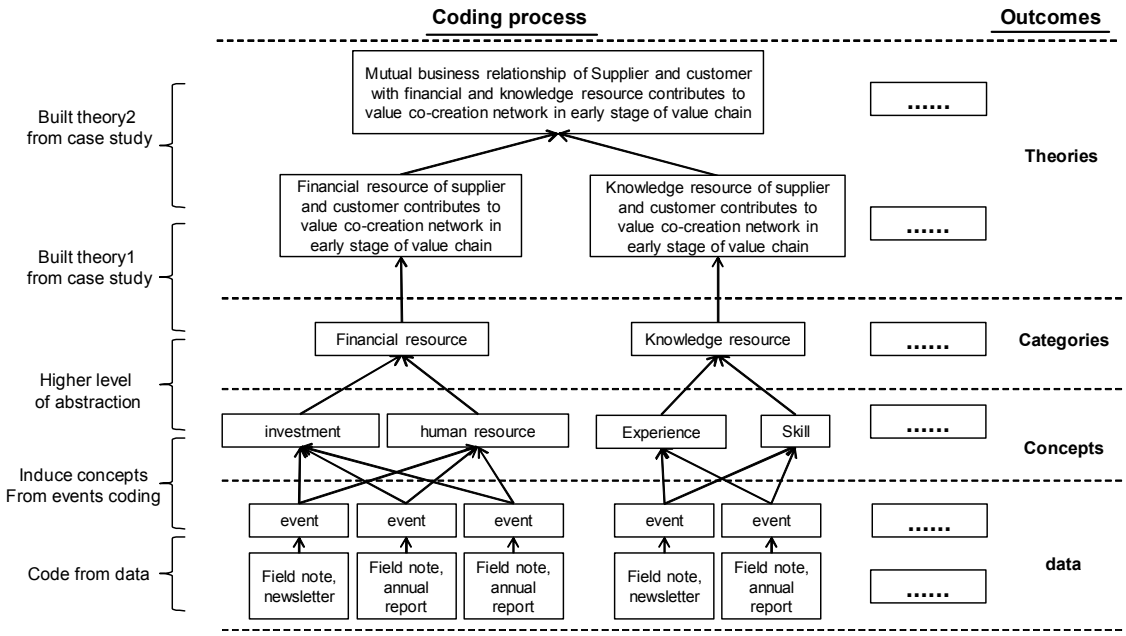
Coding process
Outcomes
Mutual business relationship of Supplier and customer with financial and knowledge resource contributes to value co-creation network in early stage of value chain
Financial resource of supplier and customer contributes to value co-creation network in early stage of value chain
Knowledge resource of supplier and customer contributes to value co-creation network in early stage of value chain
Financial resource
Knowledge resource
investment
human resource
Experience
Skill
event
Field note, newsletter
Field note, annual report
Built theory2 from case study
Built theory1 from case study
Higher level of abstraction
Induce concepts From events coding
Code from data
.....
Theories
Categories
Concepts
data

Figure 5. Ground theory coding process from event analysis.

4. Research Findings

Case results from data analysis are examined in relation to the two research questions. In relation to the first research question, we examined if business relationship can be developed to co-create values at the early stage in a high-tech B2B market. The second research question is examined to understand the most critical business relationship within the early stage value co-creation network in a high-tech B2B market. According to initial research framework presented in Figure 3, actors participating as value co-creators, resources connected to actors, and developed business relationships are induced using the ground

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theory coding process (Strauss and Corbin, 1998), presented in Figure 5. Additionally, specific values are identified by adopting six relationship value benefits (Ulaga and Eggert, 2006). Each event associated with research findings is described and the referred event ID for each event is presented in Appendix A.

4.1. First research finding: business relationship and its components

4.1.1. Supplier-customer mutual business relationship (Type I)

The first type of business relationship in the Taiwan semiconductor business network is the mutual business relationship between suppliers and customers.

Participating actors of this type are the technology development team within the suppliers' and customers' organization at an early stage. They collaborated as one team reciprocally to manufacture components or sub-components of sophisticated high-tech products. Component customers need their technology development team in a high-tech B2B market because they must develop additional products tailored for their end-customers. It is worth noting that customer's active involvement is as critical at the early stage as it is at the later stage in developing high-tech products and co-creating values.

Resources connected to suppliers and customers for Type I are induced as financial resources, knowledge resources, and intellectual resources. Each resource is named as a higher level of abstraction, after subordinate concepts are coded for each type of resource, presented in Figure 5. Financial resources are identified from event ID 1 and 5. Because product or technology development at an early stage in a high-tech B2B market requires considerably large investment that cannot be provided by a single investment, suppliers and customers invested their money and human resources combined. Thus, their financial resources are connected to each other. Sustainable investments facilitate building of trust between each party along with market success; suppliers and customers can improve their business relationships.

> Taiwan foundry suppliers collaborate with leading Fabless customers by combining engineering resources for fast project development. In addition, Taiwan foundry suppliers and customers shared the cost of development and production tools. Thus, this event can add value by consistently meeting development schedules and can support the time to market for foundry suppliers and their customers (event ID : 1, 5).

Knowledge resources are identified from event ID 6, 9, and 14. High-tech products have

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sophisticated functions and structures due to innate features. Particularly, high-tech B2B products require more knowledge because component products can have limited functions to support the final set product. Additionally, full functions of component products can be understood from functions of the final set product. Due to limited information and knowledge of products, technology development teams of suppliers and customers must combine their knowledge.

> Taiwan foundry suppliers have developed a variety of technologies and products, from mobile applications to consumer applications, accumulating high-quality experience, skills, and information. Customers not only provide the product information needed by foundry suppliers to develop their process technology but also share their experience from earlier product development, such as potential weak points that can be encountered during product development. Thus, foundry suppliers can quickly improve the quality of a product based on the experience and information shared with the customer, and can build up know-how to develop their customer's chips (event ID : 6, 9, 14).

Intellectual resources are uniquely identified at an early stage from event ID 13 and 24. Because high-tech products involve a variety of core technologies, many incumbent leaders in a market want to protect their technology from new entrants. Patents are an effective way to protect the owner of technology from future competition with new entrants. In a high-tech B2B market, the technology development team of suppliers and customers facilitates protection of their intellectual resources.

> Taiwan foundry suppliers protect their customer's intellectual property (IP) by avoiding conflicts with the customers in business areas and by focusing on a pure foundry business model. Thus, it improves the suppliers' service support by protecting their customer's business areas and builds up suppliers' know-how for customer satisfaction (event ID : 13, 24).

Therefore, the supplier-customer mutual business relationship is developed at an early stage to co-create relationship benefits by participating actors (suppliers and customers) and their connected resources (financial, knowledge, and intellectual resources) in the Taiwan semiconductor business network.

4.1.2. Supplier-centric business relationship (Type II)

The supplier-centric business relationship between suppliers and partners is the second type of business relationship in the Taiwan semiconductor business network.

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The technology development team within the suppliers' and partners' organization is participating as actors of this Type II at an early stage. Design, manufacturing, testing, and assembly partners were observed as partners within the Taiwan semiconductor business network. They collaborate to manufacture components or sub-components of sophisticated high-tech products. However, this Type II relationship differs from Type I since suppliers are more dominant in leading their business relationship with partners. High-tech products require specialized functions, such as supplement of raw materials or equipment, the bottom level design of a core area, or testing of integrated products during technology development; thus, manufacturing, design, testing, or assembly partners participate to compensate for specialized functions. Partners' involvement in supporting suppliers is critical at an early stage of high-tech B2B market in developing high-tech technologies and co-creating values.

Resources connected to suppliers and partners for the Type II relationship are induced as financial resources, knowledge resources, and efficiency resources. Financial resources are identified from event ID 3, 19, and 20. Financial resources of suppliers and partners relate to leadership of suppliers. Sustainable integration of financial investments facilitates building of trust between each party with market success; thus, suppliers and partners can improve business relationships.

> The partners of intellectual property (IP) and the electronic data automation place engineering resources with suppliers to develop and build an open innovation platform (OIP), which is a design network that encompasses all design implementation services to reduce design barriers and efficiently improve first-time silicon success. Materials, equipment, assembly, and tester vendors share the investment costs with suppliers because advanced technology development requires large investments, and a single vendor cannot afford those investment costs. Thus, suppliers can meet development schedules and support the time to market of its customers by collaborating with partners (event ID : 3, 19, 20).

Knowledge resources are induced from event ID 7 and 28. Architecture and modules of high-tech B2B products are frequently changed to follow market requirements from customers. Because the technology development team of suppliers outsources part of technology development with partners, such as development of raw materials or manufacturing equipment, suppliers must lead partners in overall technological development by combining their knowledge of high-tech products with partners.

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> Manufacturing partners share information and co-develop advanced equipment or materials with suppliers. Databases are built to share knowledge of intellectual property (IP) development between design partners and suppliers. Shared information and knowledge obtained from partners quickly facilitate improvement of the suppliers' product quality, as well as buildup of suppliers' know-how for fast product development. (event ID : 7, 28).

Efficiency resources are uniquely identified at an early stage from event ID 11 and 18, as it is not in place at the later stage in the value chain. Technological development of high-tech B2B products is time-consuming and requires dedicated effort from engineering teams, particularly for advanced technologies. Improvement of efficiency is the best strategy to reduce time and effort invested in technological development. With leadership of suppliers, suppliers and partners can implement an effective solution or optimized systems to improve efficiency.

> Sophisticated IT solutions are implemented within the manufacturing system to optimize equipment, manufacturing processes, and semiconductor performance. Thus, IT solutions improve production efficiency, effectiveness, and engineering capability. It improves suppliers' service support in relation to information management and facilitates improvement of the product's quality because of improved efficiency (event ID : 11, 18).

Thus, supplier-centric business relationships between suppliers and partners are developed successfully at an early stage in a high-tech B2B market, by co-creating relationship benefits. It is notable that supplier-centric business relationships are uniquely in place at early stage in a high-tech B2B market because it is not in place at the later stage in the value chain.

4.1.3. Network-based (Supplier-customer-partner) business relationship (Type III)

The third type of business relationship in the Taiwan semiconductor business network is the network-based business relationship.

Participating actors of this type are the technology development team within suppliers', customers', and partners' organizations at an early stage. They interact as one agglomerate to manufacture components or sub-components of sophisticated high-tech products. These actors have a common goal to develop tailored technology for customers, and meet the time-to-market of targeted products in a high-tech B2B market. Suppliers, customers, and partners in the high-tech B2B are linked since suppliers will be customers again for the next level of the supply chain during the B2B transaction, presented in Figure 2.

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Resources connected to actors for this type are induced as financial, knowledge, and efficiency resources. Financial resources are identified from event ID 2 and 4. Because technology development at an early stage in a high-tech B2B market requires integrated investments that seamlessly connect appropriate investment at the required stage, all actors within the network invest their combined money and human resources and behavior is like that of 'living organisms' in an organic system. Integrated investments facilitate building of trust among involved parties, thus involved parties can develop their business relationship successfully by improving perceptions of each other based on successful experience of entering the targeted market.

> Taiwan foundry suppliers, Fabless customers, and IP/EDA design partners put their engineering resources together to develop and build open innovation platform. Additionally, Taiwan foundry suppliers, Fabless customers, and assembly/testing partners invest their money for advanced assembly or tester development suitable for advanced technology development. Thus, these events can add value by consistently meeting development schedules and can support the time to market for foundry suppliers, their customers, and partners (event ID : 2, 4).

Knowledge resources are induced from event ID 27, 34, and 8. Because high-tech B2B products have sophisticated functions and structures due to innate features, integrated knowledge of products is mandatory for rapid technological development. Like the way living organisms think and behave, knowledge of products, materials or designs in the Taiwan semiconductor business network is integrated during technological development. Seamless connection between different types of knowledge in a high-tech B2B market enables rapid improvement of product quality and builds on know-how.

> Taiwan foundry suppliers, design partners, and customers held technology symposium regularly to exchange and absorb external knowledge on product development. A database is built to share knowledge about intellectual property (IP) development between the design partners, customers, and foundry suppliers. Shared information and the knowledge obtained quickly facilitates buildup of suppliers' know-how for fast product development (event ID : 27, 34, 8).

Efficiency resources are identified for type III at an early stage from event ID 10. As mentioned earlier, technological development of high-tech B2B products is time-consuming and requires dedicated effort by engineering teams, particularly for advanced technologies. The technology development team of all actors exerts time and effort to accomplish timely

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development of targeted products. Because resources of involved parties are integrated seamlessly without duplicate investment, improvement of efficiency is achieved during technological development.

> Taiwan foundry suppliers and customers exerted its efforts with its manufacturing partners to reinforce exploratory development work for new transistors and technologies, and they can accomplish timely development of advanced technologies in each generation. Thus, timely development enables achievement of time to market for suppliers and customers, and facilitates buildup of suppliers' know-how on development of advanced technologies (event ID : 10).

The technology development team of all actors within the network interacts as one agglomerate to develop sophisticated high-tech products, thereby enabling building of trust with improvement of mutual perception based on successful experiences. Additionally, the 'guanxi effect' (Chinese connection) can contribute to developing a personal business relationship in the Taiwan business network among Confucian societies. Therefore, network-based business relationships were built successfully by co-creating relationship benefits, such as time-to-market, service support, or supplier know-how, at an early stage in a high-tech B2B market.

4.1.4. Summary of business relationships at an early stage value co-creation network

In summary, findings from this study indicate three different types of business relationships contributing to value co-creation at an early stage in a high-tech B2B market, presented in Table 2. Based on the case study of the Taiwan semiconductor business network, supplier-customer mutual, supplier-centric, and network-based business relationships are identified at an early stage in a high-tech B2B market. Thus, the first research question is answered from findings of business relationships. Results from the three types of business relationships support findings in the next section, identifying relative significance of business relationships to answer the second research question.

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Table 2. Types of business relationships consisting of early stage value co-creation network in high-tech B2B market.

Types of business relationship	Participating actors	Resources connected to actors	Business relationship development	Co-created relationship value benefits
Supplier-Customer mutual business relationship (Type I)	Suppliers, customers	Financial resource (investment, human resource)	Mutual business relationship development (supplier and customer) integrating financial, knowledge, and intellectual resources	Delivery performance, Time to market, Service support, Supplier knowhow
		Knowledge resource (experience, skill, information)		
		Intellectual resource (IP, patent asset)		
Supplier-centric business relationship (Type II)	Suppliers, partners	Financial resource (investment, human resource)	Supplier centric business relationship development (supplier and partner) integrating financial, knowledge, and efficiency resources	Delivery performance, Time to market, Service support, Supplier knowhow
		Knowledge resource (experience, skill, information)		
		Efficiency resource (time, effort)		
Network-based business relationship (Type III)	Suppliers, customers, partners	Financial resource (investment, human resource)	Network based business relationship development (supplier, customer, partner) integrating financial, knowledge, and efficiency resources	Delivery performance, Time to market, Service support, Supplier knowhow
		Knowledge resource (experience, skill, information)		
		Efficiency resource (time, effort)		

4.2. Second research finding: Relative importance of business relationships

To understand the most critical business relationship at an early stage in relation to the second research questions, the number of induced events at each type of business relationship was counted and the ratio of induced events at each relationship to the total events was calculated in Table 3, by displaying relative significance of qualitative data quantitatively (Miles and Huberman, 1994). The mutual supplier-customer business relationship displayed the strongest potential, comprising almost half of all events, implying that the collaborative supplier-customer business relationship is the most fundamental relationship for the value co-creation network at both early stage and later stage in the Taiwan semiconductor business network. Notably, the supplier-centric business relationship exhibited the second strongest potential, indicating that partners can participate as value co-creators at the early stage value co-creation network. The network-based business relationship revealed moderate potential at the early stage value co-creation network. Thus, the second research question is answered with findings in this section.

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Table 3. Quantitative display of value co-creation events according to business relationship types.

Types of business relationship	Participating actors	# of events	Proportion
Supplier-Customer mutual business relationship (Type I)	Supplier, customer	16	45%
Supplier-centric business relationship (Type II)	Supplier, partner	13	36%
Network-based business relationship (Type III)	Supplier, partner, customer	7	19%
Total		36	100%

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4.3. Final construct of theory

Our study proposed an a priori construct shown in Figure 3 to understand the grounding of our research. Based on initial framework, we observed how actors within an early stage value co-creation network in a high-tech B2B market develop a business relationship to co-create relationship values. Detailed actors and their resources consisting of each business relationship were induced from rich data. Initial construct was compared with data iterating towards a theory that closely fits data, as in Step 5 of Figure 4, as suggested by Eisenhardt (1989). Research findings were compared with similar or conflicting findings in previous studies in Step 6 of Figure 4. Thus, constructs were refined and integrated from case study findings. In Step 7 of Figure 4, an early stage value co-creation network was proposed as the final construct and theory in our study, as shown in Figure 6. In a high-tech B2B market, supplier-customer mutual, supplier-centric, and network-based business relationships constitute an early stage value co-creation network. Each business relationship, composed of value co-creators (supplier, customer, partner or the network) and financial, knowledge, intellectual or efficiency resources connected to actors, contributes to building an early stage value co-creation network in a high-tech B2B market. According to our study, intellectual resource, the efficiency resource, and supplier-centric business relationships are uniquely in place at early stage in a high-tech B2B market.

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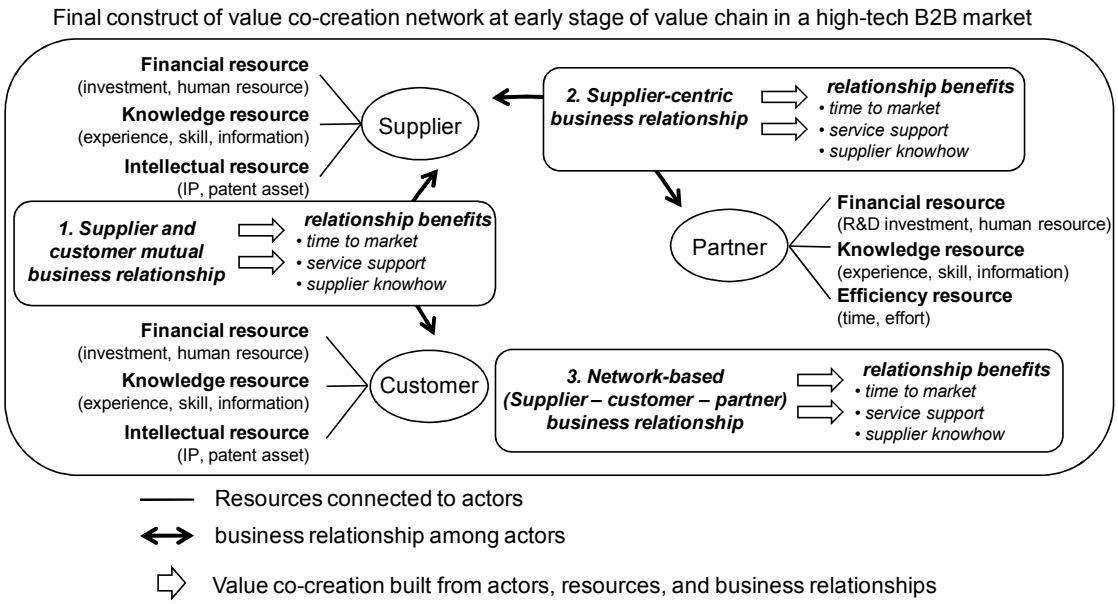

Figure 6. Early stage value co-creation network built from actors, resources, and their business relationships in a high-tech B2B market.

5. Discussion with Theoretical and Managerial Implication

5.1. Theoretical implications and further research

Our study suggests several valuable theoretical implications compared with extant research. First, extant value co-creation research focused on later stages in the value chain, such as marketing or sales in B2B markets (Guenzi and Troilo, 2006; Golfetto and Gibbert 2006), so effects or benefits of value co-creation with customers can be observed directly. In our study, we focus on a high-tech B2B market, in which complex business relationships co-exist with a variety of actors, and we explored if a value co-creation network can be built at another stage of the value chain in a high-tech B2B market. Based on the case study of the Taiwan semiconductor business network, the notion of value co-creation is extended to the early stages of the value chain, in which technological innovation is critical, and our research provides new insight suggesting that the study of value co-creation must be extended to all stages in the value chain in a high-tech B2B market.

Second, roles of customers that actively participate in the value co-creation process are stressed in the value co-creation theory (Grönroos, 1997; Prahalad and Ramaswamy, 2000; Ulaga and Eggert, 2006; Vargo and Lusch, 2008; Payne, et al., 2008). Our study also verified that customers play critical roles during the value co-creation process at an early stage in a high-tech B2B market as their roles are involved in supply-customer mutual business

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relationship and network-based business relationship. Roles of other actors, such as partners and the network, participating in the early stage value co-creation process, are newly identified in our study. Thus, value co-creators at an early stage value co-creation network are identified in a high-tech B2B market.

Third, extant research implies that understanding actors, actors' resources, and relationships among actors is vital for value co-creation research, presented in Table 1. In our study, research framework of an early stage value co-creation network in a high-tech B2B market is constructed, incorporating actors, resources, and business relationships. The final construct indicates that an early stage value co-creation network can be developed with three types of business relationships (supplier-customer mutual, supplier-centric, and network-based business relationship) by integrating financial, knowledge, intellectual, and efficiency resources, presented in Figure 6. With proposed early stage value co-creation network, relationship benefits of time-to-market, service support, and supplier know-how are observed. According to the proposed framework, our study reveals that value co-creation at an early stage differs from later stage by requiring intellectual resource, efficiency resource, and supplier-centric relationship associated with technological innovation during technology development. Despite the difference, financial resource, knowledge resource, supplier-customer relationship, and network-based relationship are fundamental to co-create values at early and later stage. Thus, actors, actors' resources, and relationships among actors can be observed analytically using the proposed framework, that will be useful in further studies to understand the value co-creation phenomenon for either the early stage or later stage in the B2B market.

Although this study has many theoretical implications through building a theory based on grounded theory coding in relation to methods and findings, the correct use of grounded theory requires more empirical studies to avoid misinterpretation and effort necessary for understanding multifaceted concepts of grounded theory should not be underestimated (Wagner, et al., 2010). This study selected the Taiwan semiconductor business network as a typical example case in the high-tech B2B market. Nonetheless, more extensive studies are required to build more consolidated theories. Further research could include several interesting topics. First, more case studies in the high-tech B2B market should be conducted to reinforce and extend our theories built from the Taiwan semiconductor business network case. The value co-creation phenomenon at an early stage of value chain can be analyzed from the perspective of proposed research framework in this study with additional case

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studies. Second, our study focuses on the early stage value co-creation network in a high-tech B2B market. Business relationships for other value chain stages, such as planning, manufacturing, sales etc., could be other interesting topics to extend our study. New questions to assess if business relationships for value co-creation can be developed for other value chain stages can be answered. Third, in the proposed early stage value co-creation network shown in Figure 6, interacting effects among different business relationships can be further investigated to understand how business relationships impact each other. By analyzing interacting effects, how actors within different relationships interacted reciprocally and how actor's resources are integrated for value co-creation will be investigated further.

As new theories on early stage value co-creation network are generated and further developed by using the grounded theory approach, the next approach using quantitative analysis, mixed methods, or meta-analysis will be required to ascertain the robust relationship between theories. Additionally, recent research implies that actors' perceptions impact development of business relationships (Corsaro and Snehota, 2010; Fiol, et al., 2011; Oinonen and Jalkala, 2015). Thus, how the perception of actors involved in an early stage value co-creation affect other actors' behavior, and ultimately impacts development of value co-creation relationships can be explored further.

5.2. Managerial implications

This study has managerial implications for technology development managers in the early stage and marketing managers in the later stage in a high-tech B2B market.

First, the supplier-customer mutual business relationship can be built with participation of suppliers and customers in the early stage of the value chain. More specifically, suppliers and customers at an early stage are technology development teams within their organizations while marketing teams will act as another suppliers and customers in the later stage in a high-tech B2B market. So far, the technology development team of suppliers and customers has mostly focused on improving technical performance of their B2B products rather than on improving mutual relationships to co-create values. However, as demonstrated in this study, the technology development team of suppliers and customers can co-create more expanded relationship benefits, such as time-to-market, service support, or supplier know-how, by developing mutual business relationship. When developing the supplier-customer mutual business relationship, the technology development team can integrate and use financial as well as knowledge resources combined from suppliers and customers to compensate for

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potential shortage of money or human resources and to understand full functions of final set products. Intellectual resources can be integrated to protect knowledge created from suppliers and customers. In addition to the semiconductor industry from the case study, the supplier-customer mutual business relationship can be extended to other high-tech industries to co-create values reciprocally.

Second, the supplier-centric business relationship can be developed with the participation of suppliers and various partners in the early stage. While the roles of suppliers and customers in a B2B market are stressed from extant literature, the roles of partners and their interaction with other actors have not gained much attention. Because partners are responsible for limited parts of functions during overall B2B product development, their roles are not explicit in the value chain and the 'boss-subordinate relationship' is more dominated by the relationship between suppliers and partners. However, as demonstrated in this study, the technology development team of suppliers and various partners can co-create more explicit relationship benefits by building the proposed supplier-centric business relationship. When developing the supplier-centric business relationship with leadership of suppliers, the technology development team of partners can supplement their investment cost, human resource, and sub-components knowledge, coming from frequent architectural or modular changes of process equipment and materials of sub-components. Partners can exert their time and effort more in supporting suppliers to expedite product development.

Third, the network-based business relationship at an early stage will consist of multiple relationships because the business network is defined as a set of two or more connected business relationships (Anderson, et al., 1994). Extant research has studied the relationship network in terms of network types or connectedness of a network at meta-analysis level (Corsaro, et al., 2012; Jaakkola and Hakanen, 2013; Gummesson and Polese, 2009; Vedel, 2016). However, this study practically demonstrated how real actors, such as suppliers, customers, or various partners, can develop the network-based relationship as one agglomerate integrating their resources in a high-tech B2B market. Because multiple relationships will exist within the network, technology development managers must prioritize relative significance of business relationships. As indicated in Table 3, supplier-customer relationships will contribute to the value co-creation significantly and other business relationships built with partners can contribute to co-creating relationship benefits at an early stage in a high-tech B2B market.

While the technology development team at an early stage is discussed intensively in this

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study to co-create values in a high-tech B2B market, this study also has managerial implications for the marketing team in the later stage of value chain. The marketing team has mostly devoted more attention to the value co-creation strategy than did the technology development team because the marketing team can interact with customers and therefore can listen to voices of customers more directly. However, as our study demonstrated that value co-creation can be extended to the early stage, the marketing team in a high-tech B2B market must turn their eyes into the early stages, in which technological innovation is critical. In a high-tech B2B market, the marketing team must encourage the technology development team to seek value co-creation strategies by building a successful business relationship with other actors. Market uncertainty is as high as technology uncertainty. The marketing team can absorb and learn from the voice of customers directly regarding market demand and technology requirements; thus, they can guide the direction of technology development.

As an overall technological or business strategy, early stage value co-creation network will be valuable in improving competitiveness and innovation capabilities of suppliers, customers, and partners within the network. Furthermore, the research findings provide new insight for academia and industry alike, as academia can extend the value co-creation theory from an in-depth case study, and industry can acquire knowledge and implications of how to apply theories in real practice.

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Appendix A

The event ID, summary of events, and data sources for data analysis are listed below:

Types	Event ID	Summary of events	Data Sources
I	event1	Suppliers collaborated with leading Fabless customers (Xilinx, Qualcomm, Apple etc.) putting engineering resources together for fast project development	Field note, Trade newsletter
	event5	Suppliers and customers shared cost of development NRE & production tools	Field note, interview data
	event6	Suppliers' technology development experience, skill, and knowledge are combined with customer's product & design information	Field note, interview data
	event9	Development learning with customers reflects on the next generation technology development.	Field note, interview data
	event13	Suppliers protects customer's IP by avoiding conflicts of business area and focusing on pure-foundry business model.	Field note, Annual report (2013)
	event14	To facilitate customer communication and information access on real-time basis, Suppliers offers EFOUNDRY service, which customers can access information and control manufacturing of their products	Field note, Annual report (2014), Trade Newsletter
	event15	Suppliers conducts annual customer satisfaction survey with all customers, either by web or interview survey. All customer feedbacks are reviewed and developed into improvement plan to enhance customer satisfaction and trust	Field note, Annual report (2013)
	event17	Suppliers collaborated with leading Fabless customers (Xilinx, Qualcomm, Apple etc.) regarding technology development and design enablement to lead the market	Field note, Trade newsletter
	event22	Suppliers leads advanced technology development and build up enough capacity for customers by aggressive investment	Field note, Annual report (2013), Trade Newsletter
	event23	Suppliers started world first 12 inch wafer production in 2001 and offered a variety of technology portfolio from baseline to derivative technology to meet customer requirements	Field note, Annual report (2013), Trade Newsletter
	event24	Suppliers focuses on pure-play foundry business model only and doesn't compete with customers to avoid conflict of business area	Field note, Annual report (2013), Trade Newsletter
	event25	Suppliers makes a huge profit from second and third wave customers by using depreciated manufacturing facility after the first wave customers pave technology path and improve wafer yield	Field note, Analyst report
	event29	Schedule was co-managed with customers during NPD	Field note, interview data
	event33	Suppliers-Online, web-based efoundry service, provides all information from manufacturing to logistics for customers transparently	Field note, Web site
	event35	Suppliers keeps enough production capacity for customers in order to supply for any demand fluctuation	Field note, interview data
	event36	Suppliers and design partners provides dedicated technology and design service for customers at customer sites	Field note, interview data
II	event31	Suppliers regularly reviews the quality, delivery, cost and service performance of its manufacturing partners. A periodic audit ensures that Suppliers can maintain the highest quality in its products	Field note, Annual report (2014)
	event32	Suppliers procures manufacturing supplies from multiple sources to ensure adequate supplies for volume manufacturing and to appropriately manage supply risk	Field note, Annual report (2014)
	event3	Suppliers, material, and equipment vendors invest together for advanced material or equipment development	Field note, Annual report (2013)
	event7	Manufacturing partners shared information and co-developed advanced equipments and materials with Suppliers	Field note
	event11	Sophisticated IT solutions are implemented to optimize equipment, process and yield performance. They improved production efficiency, effectiveness and engineering capability.	Field note, Annual report (2013)
	event12	Suppliers and its design partners offer customers a rich portfolio of libraries and IP that are built from OIP. A strong portfolio of intellectual property rights strengthens Suppliers' technology leadership and protects rights of design partners.	Field note, Annual report (2013), Trade Newsletter
	event18	Suppliers forms OIP (Open Innovation Platform) with IP and EDA partners to provide efficient and innovative design service to customers	Field note, Annual report (2013)
	event19	Suppliers forms manufacturing ecosystem with material and equipment providers to provide transparent and innovative service to customers	Field note
	event20	Suppliers forms backend ecosystem with assembly and testing vendors to provide transparent and innovative service to customers	Field note
	event21	University shuttle program between Suppliers and leading research universities contributes to excellence in advancing technologies and in nurturing new talents in semiconductor field.	Field note, Annual report (2013)
	event26	Suppliers and IP/EDA partners build OIP (Open Innovation Platform) together and leverage each other's design service capability	Field note, Trade Newsletter
	event28	Suppliers and manufacturing partners leads technology innovation from scaling innovation (to 130um-generation) through material innovation (90nm to 20nm-generation) to structure innovation (14nm-generation)	Field note, Trade Newsletter
	event30	The majority of the manufacturing partners are located in different geographic locations, minimizing supply risk to Suppliers	Field note, Annual report (2014)
III	event27	Suppliers, design partners, and customers held technology symposium regularly in order to exchange and absorb external knowledge	Field note, interview data
	event34	Suppliers-Direct, web-based efoundry service, integrates database of both customers and partners in order to exchange manufacturing information and manage supply chain risks	Field note, Web site
	event2	Suppliers, customers and IP/EDA partners puts engineering resources together to develop and build OIP (Open Innovation Platform)	Field note, Annual report (2014)
	event4	Suppliers, customers, assembly, and testing house invest together for advanced assembly and tester development	Field note
	event8	Database is built to share knowledge about IP development between OIP partner, customers and Suppliers	Field note
	event10	Suppliers and customrs put its efforts to reinforce exploratory development work on new transistors and technologies with manufacturing partners, and accomplished timely development of advanced technologies at each generation.	Field note, Annual report (2013), Trade Newsletter
	event16	Suppliers' OIP partner management portal facilitates communication with ecosystem partners and customers for efficient business productivity	Field note, Annual report (2013)

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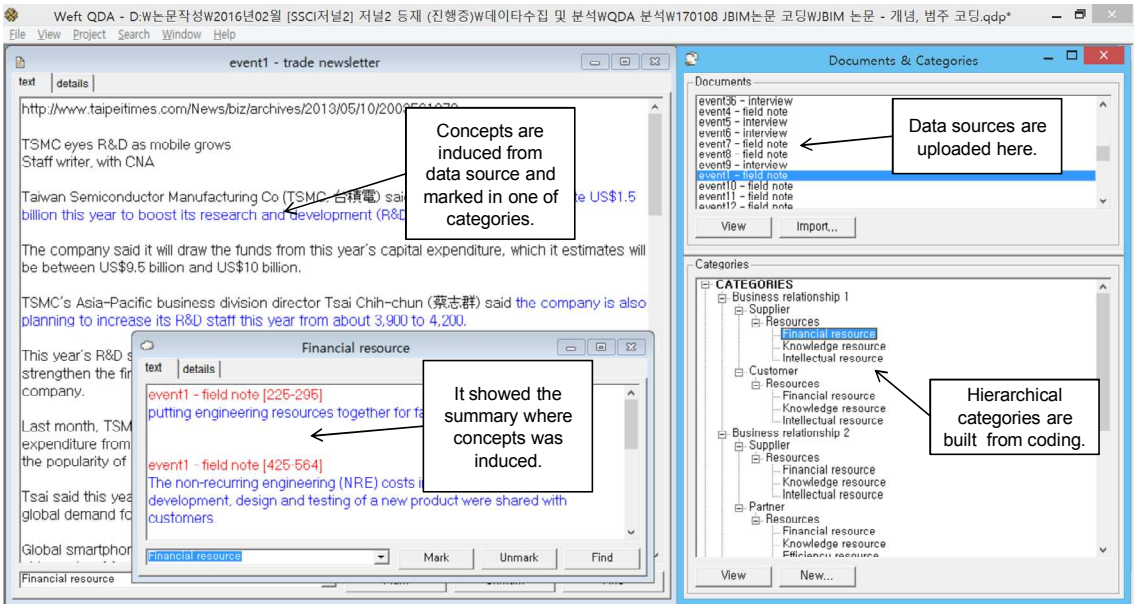
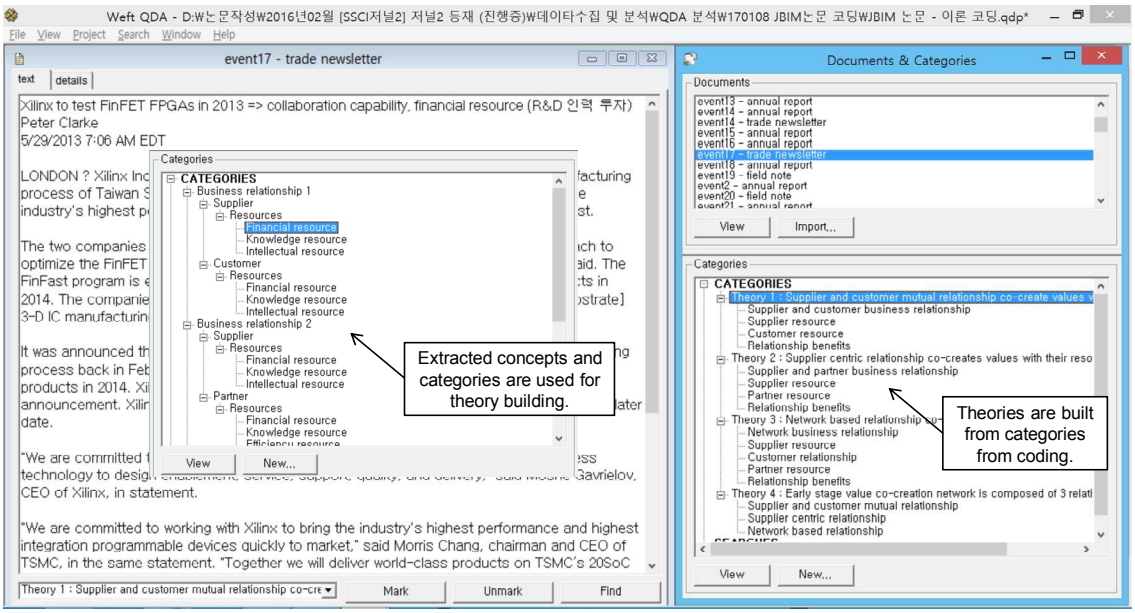
Appendix B-1

An example of CAQDA coding used to extract concepts and categories from the data sources is presented below.


Concepts are induced from data source and marked in one of categories.
Data sources are uploaded here.
It showed the summary where concepts was induced.
Hierarchical categories are built from coding.

Appendix B-2

An example of CAQDA coding used to build theories is presented below.



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List of Tables

Table 1. Literature review from the perspective of actors, actors' resources, and relationships among actors for value co-creation.

Perspective	Category	References
Actors	Customers	Grönroos (1997), Prahalad and Ramaswamy (2000), Vargo and Lusch (2008), Payne et al. (2008)
	Suppliers	Walter et al. (2001), Ulaga and Eggert (2006)
	Other actors (partners, alliances, industry sponsors, stakeholders etc.)	Daniel et al. (2002), Möller and Törrönen (2003), Ballantyne (2011), Frow and Payne (2011)
	all social and economic actors (customers, firms, etc.)	Vargo and Lusch (2008, 2011)
Actor's resources	Monetary or human resources	Daniel et al. (2002), Corsaro et al. (2012)
	Knowledge resource	Jaakkola and Hakanen (2013), Hakanen (2014), Lacoste (2016), Eslami and Lakemond (2016)
	Operant resources (knowledge and skills)	Vargo and Lusch (2008, 2011), Jaakkola and Hakanen (2013)
	Technology resource	Vargo (2015), Akaka and Vargo (2014)
	Resource access strategies	Rusanen et al. (2014)
Relationships among actors	Customer and supplier business relationship	Anderson and Narus (1998), Mohr and Spekman (1994), Morgan and Hunt (1994), Grönroos (2000), Ravald and Grönroos (1996)
	Relationship benefits as outcomes of successful relationship	Ulaga and Eggert (2006), Palmatier (2008)
	Types of business network (single, dyad or network)	Corsaro et al. (2012), Jaakkola and Hakanen (2013)
	Connectedness of relationships	Vedel (2016)
	Dynamics of triadic relationships	Kowalkowski et al. (2016)
	Many-to-many relationship	Gummesson and Polese (2009)
	Actors' perception on the development of business relationships	Corsaro and Snehota (2010), Fiol et al. (2011), Oinonen and Jalkala (2015)

Table 2. Types of business relationships consisting of value co-creation network at an early stage of value chain in high-tech B2B market.

Types of business relationship	Participating actors	Resources connected to actors	Business relationship development	Co-created relationship value benefits
Supplier-Customer mutual business relationship (Type I)	Suppliers, customers	Financial resource (investment, human resource) Knowledge resource (experience, skill, information) Intellectual resource (IP, patent asset)	Mutual business relationship development (supplier and customer) integrating financial, knowledge, and intellectual resources	Delivery performance, Time to market, Service support, Supplier knowhow
Supplier-centric business relationship (Type II)	Suppliers, partners	Financial resource (investment, human resource) Knowledge resource (experience, skill, information) Efficiency resource (time, effort)	Supplier centric business relationship development (supplier and partner) integrating financial, knowledge, and efficiency resources	Delivery performance, Time to market, Service support, Supplier knowhow
Network-based business relationship (Type III)	Suppliers, customers, partners	Financial resource (investment, human resource) Knowledge resource (experience, skill, information) Efficiency resource (time, effort)	Network based business relationship development (supplier, customer, partner) integrating financial, knowledge, and efficiency resources	Delivery performance, Time to market, Service support, Supplier knowhow

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Table 3. Quantitative display of value co-creation events according to business relationship types.

Types of business relationship	Participating actors	# of events	Proportion
Supplier-Customer mutual business relationship (Type I)	Supplier, customer	16	45%
Supplier-centric business relationship (Type II)	Supplier, partner	13	36%
Network-based business relationship (Type III)	Supplier, partner, customer	7	19%
Total		36	100%

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List of Figures

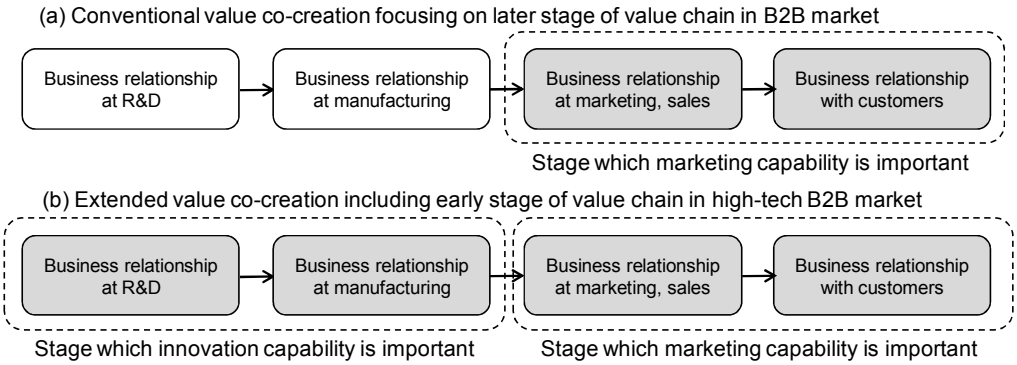
(a) Conventional value co-creation focusing on later stage of value chain in B2B market
Business relationship at R&D
Business relationship at manufacturing
Business relationship at marketing, sales
Business relationship with customers
Stage which marketing capability is important
(b) Extended value co-creation including early stage of value chain in high-tech B2B market
Business relationship at R&D
Business relationship at manufacturing
Business relationship at marketing, sales
Business relationship with customers
Stage which innovation capability is important
Stage which marketing capability is important

Figure 1. Conventional and extended value co-creation in value chain of B2B and high-tech B2B market.

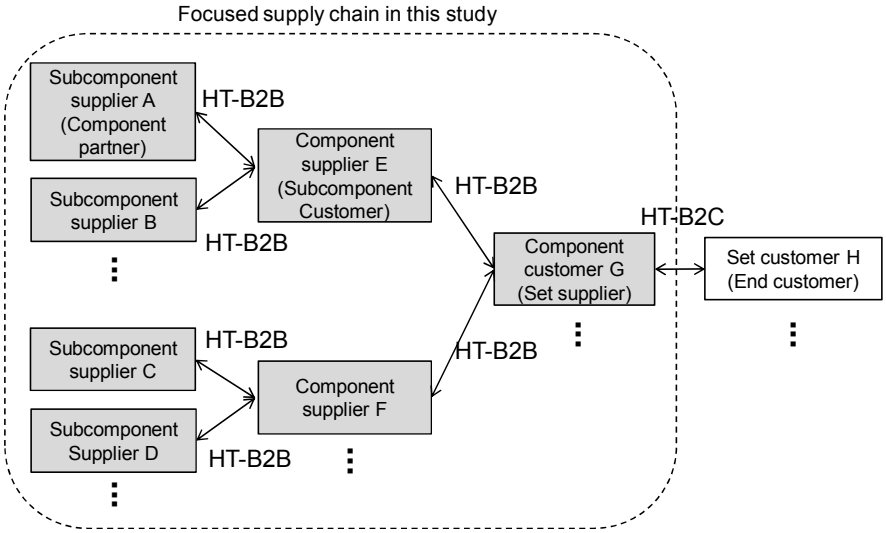

Figure 2. Comparison of high-tech B2B and B2C transactions in the supply chain.

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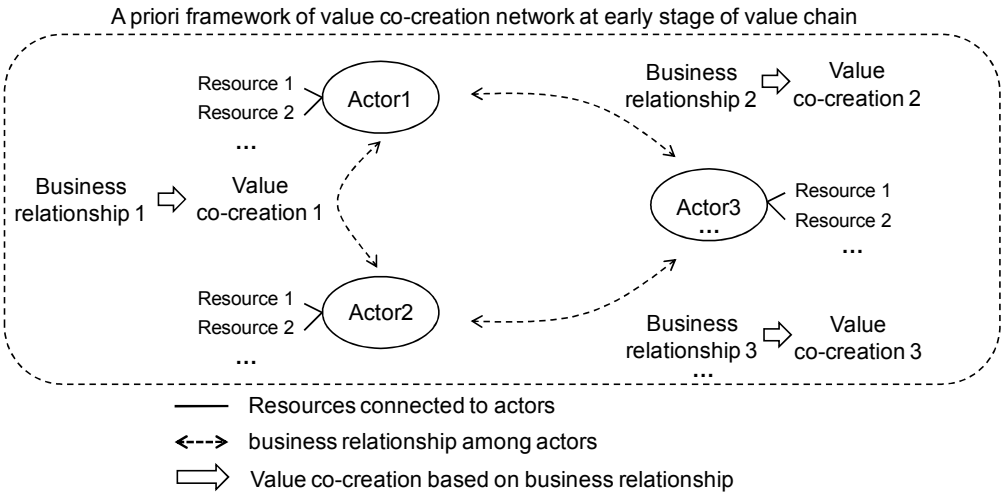

Figure 3. Initial research framework of early stage value co-creation network in terms of actor, resource, and business relationship.

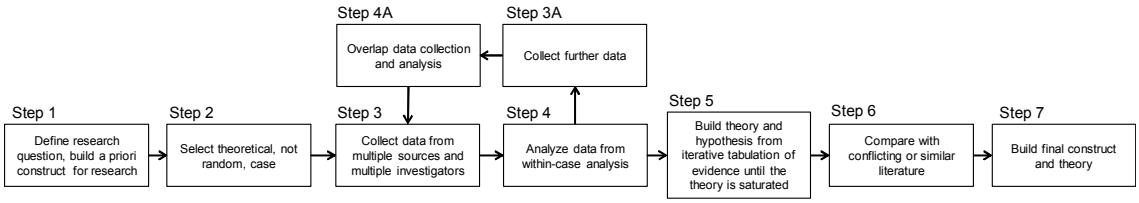
Step 1
Define research question, build a priori construct for research
Step 2
Select theoretical, not random, case
Step 3
Collect data from multiple sources and multiple investigators
Step 4A
Overlap data collection and analysis
Step 3A
Collect further data
Step 4
Analyze data from within-case analysis
Step 5
Build theory and hypothesis from iterative tabulation of evidence until the theory is saturated
Step 6
Compare with conflicting or similar literature
Step 7
Build final construct and theory

Figure 4. Process of building a theory from a case study.

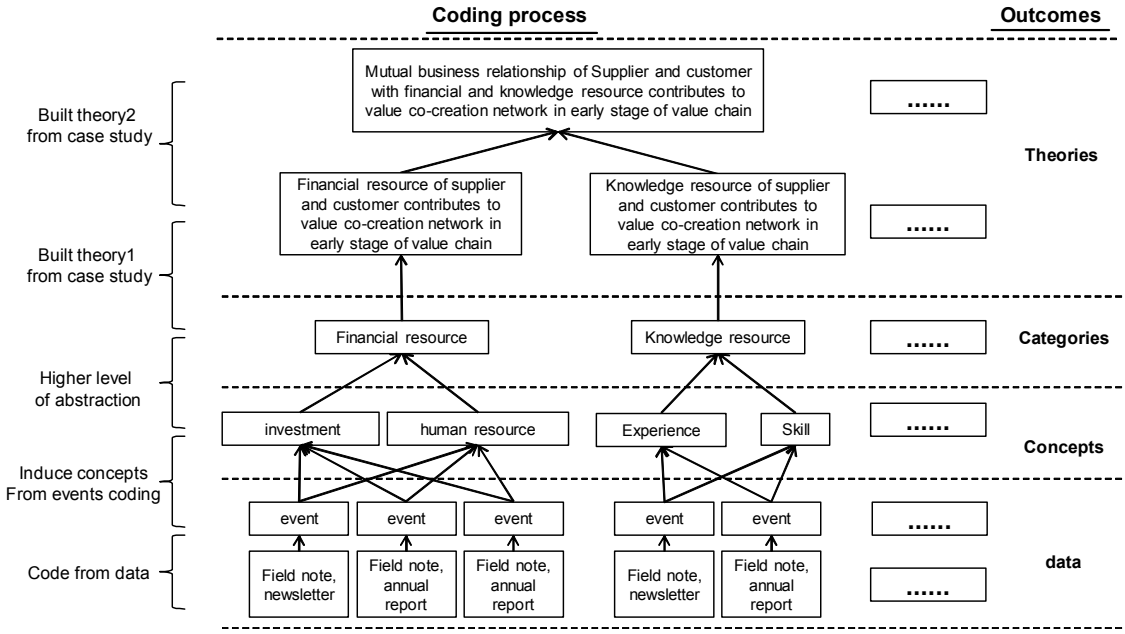
Coding process
Outcomes
Built theory2 from case study
Built theory1 from case study
Higher level of abstraction
Induce concepts From events coding
Code from data
Mutual business relationship of Supplier and customer with financial and knowledge resource contributes to value co-creation network in early stage of value chain
Financial resource of supplier and customer contributes to value co-creation network in early stage of value chain
Knowledge resource of supplier and customer contributes to value co-creation network in early stage of value chain
Financial resource
Knowledge resource
investment
human resource
Experience
Skill
event
Field note, newsletter
Field note, annual report
.....
Theories
Categories
Concepts
data

Figure 5. Ground theory coding process from event analysis.

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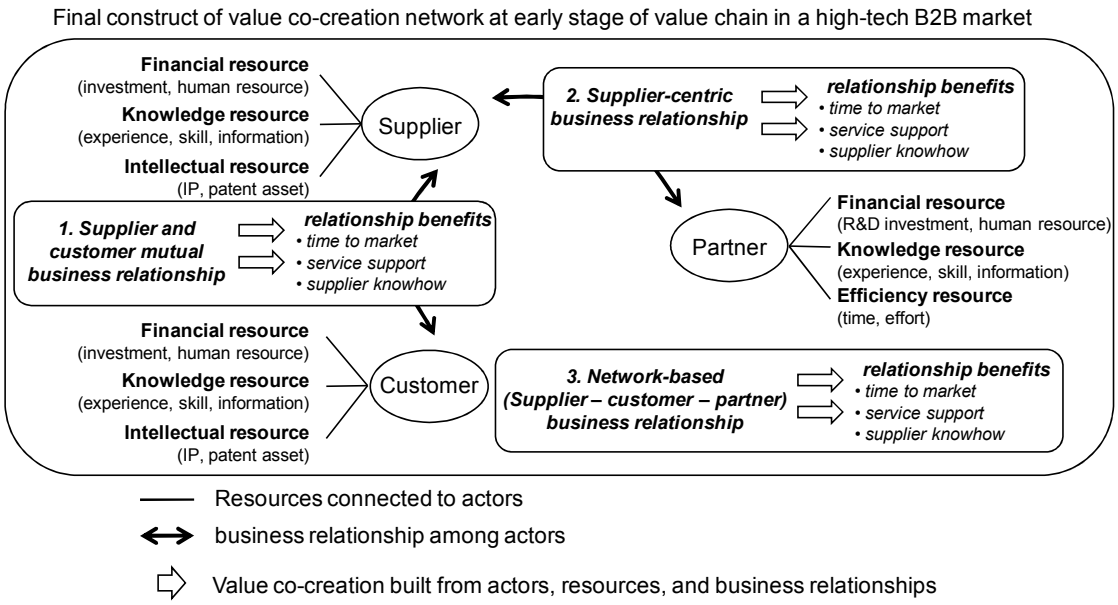

Figure 6. Early stage value co-creation network built from actors, resources, and their business relationships in a high-tech B2B market.

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